REMARKS

Amendments To The Specification

The Applicants have amended claims 15-46 to more particularly point out and claim the present invention over the prior art.

Specifically, claim 15 has been amended to incorporate the subject matter of claims 16 and 21 and an interfacial layer located between the layer of light emissive material and the electron transport layer referred to in both claims 38 and 39. As a result of these amendments, claims 38 and 39 have been amended accordingly, and claims 16 and 21 whose subject matter are incorporated into amended claim 15 have been cancelled. Claims 27, 28 and 29 have also been cancelled from the application. Furthermore, new claims 47 to 49 are being added hereby are to specify the device applications of the structure which gives ohmic contact, which includes electroluminescent device and non-electroluminescent devices such as solar cells and thin-film transistors. These claims are supported in the specification as listed on page 10, lines 9-15.

In addition to the above-mentioned claim amendments, the Applicants have also amended description page 6 containing the Summary of Invention to insert the subject matter of amended claims 23 and 25. Description page 11 has also been amended to insert the subject matter of amended claim 40. Since the subject matter of these claims is being inserted into the specification and is already in the claims as filed, Applicants submit no new matter is being added by these amendments.

Description pages 5 and 6 have also been amended to reflect the amendments to claim 15.

It is respectfully submitted that the amendments made herein are to more succinctly and clearly recite the invention. All the amendments are supported by the application as originally filed, and therefore no new matter has been added.

Obvious Double Patenting

In the Office Action dated June 2, 2006, the Examiner has provisionally rejected claims 1-46 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-39 of copending application Serial No. 11/257,393. The Examiner has also provisionally rejected claims 1-46 on the grounds of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-34 of copending application Serial No. 11/260,469.

Applicants respectfully request reconsideration and withdrawal of these double patenting rejections. With respect to copending application Serial No. 11/260,469, Applicants disagree with the Examiner that the claims of '469 are not patentably distinct from the present claims for the following reasons.

Copending application Serial No. 11/260,469 is directed to a multilayer hole injection layer structure which includes a conductive layer with a hole injection layer comprised of fullerenes as recited in subparagraph b) of claim 1. Claim 2 further introduces a second hole injection layer of organic molecules. This is distinct from the present application in which the electron transport layer (ETL) is comprised of fullerenes. Note that claim 1 of Serial No. 11/260,469 is not restricted to the ETL being comprised of fullerenes as is recited in claim 1 of the present application.

The present application defines the "hole injection layer" on page 9, lines 6 to 9:

"As used herein, the phrase "hole injection layer (or hole injection electrode)" means a thin film layer having a primary function of facilitating hole injection into a hole transport layer and the hole injection layer is typically the anode."

The device described on page 12, lines 2 to 3 simply states:

"a conductive anode electrode layer 30 for hole injection".

Therefore applicants respectfully submit the subject matter of claims 1 and 2 of copending application Serial No. 11/260,469 recite subject matter patentably distinct from the present claims.

While the Applicants respectfully assert that the obviousness-type double patenting rejections should be withdrawn for the reasons set forth above, the Applicants further note that these rejections are provisional. Accordingly, the Applicants understand that if this nonstatutory obviousness-type double patenting rejection is the only rejection remaining in this, the earlier filed, application, then the Examiner should withdraw the double patenting rejection in this application to thereby permit it to issue without the need of a terminal disclaimer. However, if the copending applications, Serial Nos. 11/260,496 and 11/257,393 issue before this application, then the Applicants understand that a terminal disclaimer may have to be filed during the prosecution of this application to overcome the double patenting rejection.

Patentability Of Claims Over The Cited Reference

The Examiner has rejected claims 1-24, 26-31, 33-38 and 41-46 as being unpatentable over Czerw et al. (U.S. Patent No. 6,833,201), and claims 25 and 32 as being unpatentable over Hung et al. (U.S. Patent No. 6,069,442). With regard to the Japanese patent application corresponding to this US application, several references were cited numbered R1 to R8. For the Examiner's consideration, copies of the references cited in the Japanese application are being submitted in a Supplement Information Statement and where available English Abstracts for these references R1 to R8 and any corresponding foreign patent applications in English.

The Examiner is respectfully requested to withdraw the rejections under Czerw and the combination of Czerw and Hung in view of the above-noted amendments and the following comments. Furthermore, in order to expedite the prosecution of this U.S. Patent Application, the following is an analysis of the

portions of the prior art cited by the Japanese Examiner (translated into English) and how the present claims distinguish over the prior art.

With respect to claims 1 to 14, Applicants respectfully submit there is nothing in Czerw or R1 to R8 which discloses a structure as recited in claims 1 and 10 characterized in that it exhibits Ohmic behavior.

Claim 1 of the present application recites a layered structure for making electrical contact to various devices which exhibits Ohmic contact for carriers going through the layered structure. This structure is not *per se* an electroluminescent (EL) device in that the recited layered structure does not contain an EL layer. Rather, it does include a fullerene layer which contacts the substrate of an electronic or optoelectronic device and a fluoride compound containing layer located directly on the fullerene layer and an electrode layer on top of the fluoride containing layer.

Claim 10 of the present application recites a layered structure for making electrical contact to various devices which exhibits Ohmic contact for carriers going through the layered structure. This structure is not *per se* an electroluminescent (EL) device in that the recited layered structure does not contain an EL layer. It does include a fullerene layer which contacts the substrate of an electronic or optoelectronic device and a low work function material containing layer located directly on the fullerene layer and an electrode layer on top of the low work function material containing layer.

Therefore, regarding claims 1 and 10, Applicants respectfully submit that neither Czerw or References 1 to 8 do not disclose or even suggest a layered structure including a fullerene layer which is applied onto a surface of a functional device with a layer of a fluoride compound (claim 1) or low work function material, claim (10) located on the fullerene layer and an electrically conductive layer formed on the fluoride compound in which the structure is characterized in that it exhibits ***ohmic behaviour***. Czerw does not disclose a pure layer of fullerenes, rather fullerene nanotubes are covalently bound to PPV and used in the *light emission* layer of an EL device, see column 6, lines 23 to 35 make clear

the fullerene-PPV composite is used in the emission layer, and column 6, lines 63 to 65 which refers to the EL light emitting layer 10 containing the "compound as set forth above" which refers to the PPV-fullerene compound, see also Example 1 in column 7, lines 17 to 28.

This feature of Ohmic behavior exhibited by the structures recited in claims 1 and 10 was a ***very surprising and unexpected result***. The Examiner's attention is directed to page 11, lines 13 to 20 of the specification where this feature of Ohmic behavior is clearly discussed. Applicants believe there is nothing in Czerw and R1 to R8 which discloses this structure at all.

The Examiner's attention is directed to Figure 2 of the present application in which this very surprising and startling result is shown. Specifically, the dashed curve in the current density versus voltage plot corresponds to the prior art layered structure Al/C60, while the linear plot corresponds to the layered structure recited in claim 1, Al/LiF/C60. The current/voltage plot for the prior art Al/C60 layered structure shows strong rectifying characteristics while the current/voltage plot for the Al/LiF/C60 structure is highly linear with a very steep slope, showing that this layered structure exhibits ohmic behavior with low resistance.

Further, as mentioned above this attainment of Ohmic behaviour is a very important result and quite unexpected. It means that devices can be produced which exhibit much lower voltage drops than before which increases the efficiency of such devices quite dramatically. The application of this contact includes electroluminescent device and NON-ELECTROLUMINESCENT DEVICES such as solar cells, thin-film transistors. New claims 47-49 specify this feature and the subject matter of these new claims is fully supported in the description on page 10, lines 12 to 15.

With particular emphasis on R1, claim 23 of Reference 1 recites an EL structure having a hole injection electrode and an electron injection electrode and an EL material sandwiched between the hole injection electrode and the electron injection electrode, with the electron injection layer being a laminate structure of

a metal lithium (Li) thin film and an aluminum (Al) film. This structure does **not** include a fullerene layer which is to be contacted to a substrate and having either a fluoride containing layer or a low work function material layer on top of the fullerene layer sandwiched between a conducting metal overlayer and a fullerene layer. Thus the recited structure in claim 23 does not give the structure of Applicants' claims 1 or 10.

Claim 24 of Reference 1 recites the thickness of the Li layer to be from 5 angstroms to 25 angstroms. This still does not give the structure of claims 1 or 10.

Claim 33 of Reference 1 recites another EL structure for emitting light which includes again a hole injection electrode, an electron injection electrode and a luminescent functional layer sandwiched between the hole and electron injection layers. In this structure the luminescent functional layer comprises a laminated structure of a hole transport material and an electron transport layer comprising fullerenes. Thus this structure is also an EL emitting structure with four layers in which the luminescent functional layer appears to include a fullerene containing hole transport layer and a fullerene containing electron transport layer. Thus claim 33 does not disclose the same structures of Applicant's claims 1 and 10 which includes a fullerene layer to be contacted to a surface of a device and a fluoride containing or low work function material layer on top of the fullerene layer.

Similarly claim 34 of Reference 1 discloses an EL element with hole injection and electron injection layers with a function EL layer being a laminate of a hole transport EL layer which includes fullerenes and an electron transport layer including fullerenes.

Therefore none of claims 23, 24, 33 and 34 of Reference 1 disclose the structure of present claims 1 (or 10) which includes a fluoride containing layer (or low work function material) located directly on a fullerene layer with the fullerene layer making direct contact to a substrate.

The paragraph [0072] of the cited reference 1 generally discusses a luminescent functional layer to produce luminescence by recombination of holes and electrons and that a hole transport layer and an electron transport layer are needed.

The paragraph [0073] of the cited reference 1 teaches how to take light out through a top layer when an opaque substrate is used instead of transparent substrate in an EL light producing device. In this case an ITO layer can be used as the hole injection layer. The electron injection layer uses a laminated structure which includes a Li containing compound (LiF or LiO) with an Al electrode used for enhancing electron injection from a cathode DIRECTLY into the ELETROLUMINESCENT ORGANIC LAYER of an EL device. It is well known that fullerenes C60 and C70 are non-electroluminescent materials and are considered as inorganic substances.

The paragraph [0074] of the cited reference 1 describes that the ITO layer mentioned in paragraph [0073] may be formed by several methods and that an electron injection layer can be made as a laminate by forming a thin layer of LiF or Al_2O_3 and a thick Al film formed thereon.

The paragraphs [0093] to [0097] of the cited reference 1 make reference to claims 33 and 34 discussed above and so for the reasons discussed with respect to these claims, Applicants assert that these paragraphs do not disclose or even suggest the subject matter of claim 1, let alone claims 2 to 14.

The paragraphs [0123] and [0170] to [0171] of the cited reference 1 make reference to Examples 1 and 15 which discuss an example of an EL display device using fullerenes as an electron transport layer and a laminated electron injection electrode formed using a Li layer with an Al layer formed on the Li layer.

These paragraphs do not disclose forming a fluoride compound (or low work function material) on a fullerene layer with a metal layer on the fluoride compound (or low work function material) in such a way to obtain a layered electrical contact structure exhibiting highly ohmic behavior.

With respect to the subject matter of claim 15, this is directed to an EL device with a light emitting EL layer. In order to more distinctly and particularly define the invention, claim 15 has been amended by incorporating the subject matter of claims 16 and 21, and an interfacial layer located between the layer of light emissive material and the electron transport layer referred to in both claims 38 and 39.

Limitation f) in claim 15, as amended, covers the interfacial layer located between the fullerene layer and the light emissive layer originally recited in claim 21. Claim 38, as amended, specifically recites that the interfacial layer is the LiF layer and claim 39, as amended, now recites the interfacial layer is the layer of organic molecules originally. This feature of claim 1f) and more particularly claims 38 and 39 is disclosed generally in the description on page 6, lines 17 to line 20 of the specification as filed.

This embodiment of the device with LiF layers on either side of the fullerene electron transport layer (claims 15 and 38) works very well as can be seen from Figure 8 which compares two devices, one without this second LiF layer and the other with 1 nm thick LiF layer.

Thus the structure of claim 15 is as follows:

Substrate/Anode/HTL/EL/ETL1/ETL2(fullerene)/Fluoride containing layer/Metal

Where ETL1 is either the LiF layer (claim 16) or an organic layer (claim 17) and ETL2 is the fullerene electron transport layer.

As mentioned above Czerw does not disclose a pure layer of fullerenes, rather fullerene nanotubes are covalently bound to PPV and used in the *light emission* layer of an EL device, there is no teaching whatever of an electron transport layer comprising fullerenes as such as recited in claim 15. The prior art

structure disclosed in Reference 1 essentially discloses an EL device of the following structure:

Substrate/anode/HTL(fullerene) /EL/ETL(fullerene)/metal

Therefore, the device of present amended claim 15 is not disclosed in Czerw, or any of the References 1 to 8. Since claim 15, as amended, is new and inventive as discussed above, it is respectfully submitted that claims depending on claim 15 are also novel and inventive over the references. Similarly, the combination of Czerw and Hung do not suggest or point to the subject matter of claims 25 and 32.

An earnest effort has been made to place this application in condition for allowance which action is respectfully solicited. Should the Examiner have any questions or require anything further, it would be appreciated if the Examiner would contact the undersigned attorney-of-record at the telephone number shown below for further expediting the prosecution of the application.

Respectfully submitted,

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